(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 313 340 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.05.2003 Bulletin 2003/21

(51) Int Cl.[7]: **H04Q 7/38**

(21) Application number: **01309518.7**

(22) Date of filing: **12.11.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **LUCENT TECHNOLOGIES INC.**
Murray Hill, New Jersey 07974-0636 (US)

(72) Inventors:
- **D'Herbemont, Luc**
  75004 Paris (FR)
- **Durighello, Alain**
  91120 Palaiseau (FR)
- **Garcin, Thierry**
  75015 Paris (FR)
- **Gouere, François**
  78760 Jouars Pontchartrain (FR)

(74) Representative: **Sarup, David Alexander et al**
Lucent Technologie NS UK Limited
5 Mornington Road
Woodford Green, Essex IG8 0TU (GB)

(54) Mobile telecommunications system with improved management of its radio resources

(57) The present invention relates to a UMTS type mobile radio telecommunications system with improved management of its radio resources, said system comprising a core network communicating by means of a UTRAN network with a plurality of user equipments (30). The core network comprises a mobile switching centre or MSC (10) and at least one serving GPRS support node or SGSN (11). According to the invention, the interface (Gs) between the MSC (10) and said at least one SGSN (11) is designed to give said at least one SGSN (11) the identity of the user equipments in connected mode with said MSC (10) and possibly the identities of the serving radio network controllers connected to said MSC. Furthermore, to page one of the user equipments in connected mode with said MSC (10), said at least one SGSN (11) communicates with this user equipment through said MSC (10) or alternatively communicates directly with the concerned serving radio network controller. The effect of this is to eliminate the unnecessary sending of paging messages through the paging channels of the system.

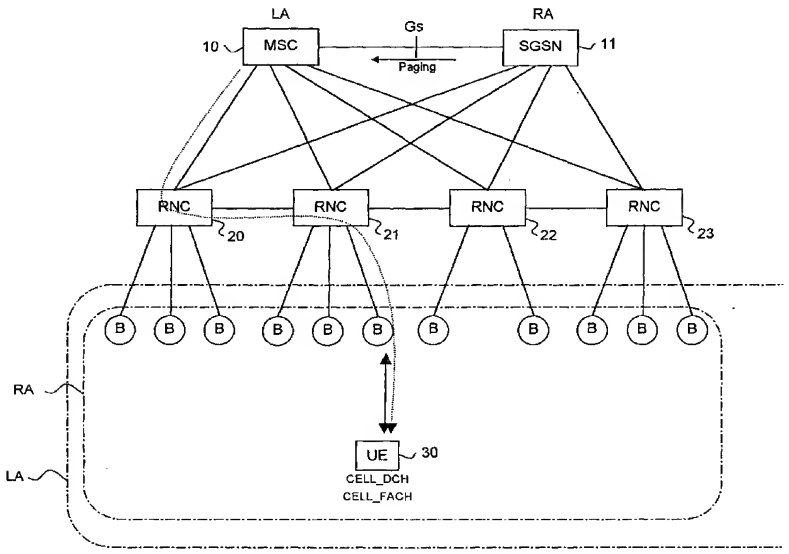

FIG.3

EP 1 313 340 A1

Description

[0001] The present invention relates to a UMTS (Universal Mobile Telephone System) type mobile radio telecommunications system with improved management of its radio resources.

[0002] In its classic form, a UMTS type telecommunications system consists of a core network, a Universal Terrestrial Radio Access Network (UTRAN) and mobile terminals commonly called user equipment (UEs). A system of this kind is shown in Figure 1. The core network comprises a mobile switching centre (MSC) referenced 10, linked to the public switched telephone network for the circuit switching service and a serving GPRS support node (SGSN) referenced 11, linked to the Internet for the packet switching service. The MSC 10 communicates with the SGSN 11 through an interface Gs. The UTRAN consists of a plurality of radio network controllers (RNCs) referenced 20 to 23, each controlling a set of logic elements called nodes B. Each RNC is connected to the MSC 10 and to the SGSN 11 of a core network by means of an interface Iu. The RNCs are also connected to one another by means of an interface Iur. Finally, each UE is connected to one or more nodes B through a radio interface, each node B serving a geographical zone called a cell.

[0003] In the example of Figure 1, the UTRAN has four RNCs 20, 21, 22 and 23 and each RNC controls two or three nodes B. An UE 30 is linked with one of the nodes B coming under the RNC 21.

[0004] The geographical zone that groups together the cells controlled by the RNCs coming under the MSC is called an LA or location area and the geographical zone that groups together the cells controlled by the RNCs coming under the SGSN is called an RA or routing area. In the example of Figure 1, these two zones are identical. However, it is not rare for several SGSNs to be associated with one and the same MSC. In this case, each SGSN has its own routing area and the location area covers all the routing areas of the SGSNs associated with the MSC.

[0005] The UEs have two operation modes: an idle mode and a connected mode. In the idle mode, no system resource is allocated specifically to the conveyance of data to and from the UE. The UE is in idle mode for example after it has been powered on. In this mode, whenever the UE changes its routing area or location area, an update operation is activated to update the location registers of the network.

[0006] The UE goes into connected mode when a connection is made to the system. Thus, as soon as the data has to be transmitted to a UE in idle mode, the core network uses the UTRAN network to send a paging message to the UE concerned, asking it to go into connected mode. The UE may also go into connected mode on its own initiative.

[0007] In connected mode, the UE can take four states known as mobility states, each corresponding to a given level of activity of the UE.

[0008] In the CELL_DCH state, a dedicated channel (DCH) is assigned to the UE for the upward link and the downward link.

[0009] In the CELL_FACH state, no dedicated physical channel is assigned to the UE. This UE constantly listens to a common channel FACH (or forward access channel) in the downward link of the cell considered. For the upward link, it can use a random-access channel (RACH). In both these states, the localization of the UE is known at the cell level. Whenever the UE changes its cell, it updates the network with its new cell location.

[0010] In the CELL-PCH state, the UE monitors only the paging channel (PCH) of the cell considered. If it changes its cell, it goes into the CELL_FACH state to update the network with its new cell location.

[0011] A fourth state in connected mode, called URA_PCH, is also possible. A URA (UTRAN registration area) designates a geographical zone grouping cells that may be controlled as the case may be by different RNCs. The URA_PCH (UTRAN registration area paging channel) state is similar to the CELL_PCH state apart from the fact that the network is updated only when the UE changes its URA. In this state, the localization of the UE is only known at the URA level.

[0012] These four mobility states as well as the transitions between them are described in greater detail in the technical specification "3GPP TS 25.331 V3.5.0" of the Radio Access Network Group, Section 7, pp. 30-32 and Appendix B, pp. 615-622, updated in September 2001.

[0013] When a connection between a UE and the core network is set up, it generally makes transit through the RNC controlling the cell in which the UE is located. When the UE moves, the connection is maintained through other cells that may be controlled by other RNCs. The connection makes transit through several RNCs between the UE and the core network. The serving RNC or SRNC then designates the RNC directly linked with the core network for a given connection between the UE and the core network. The SRNC generally corresponds to the RNC used when the connection is made. The drift RNCs or DRNCs designate the RNCs through which the call makes transit but which are not directly linked with the core network for this connection.

[0014] In such a system, a part of the radio resources is allocated to the paging channel (PCH). The paging channel is a transport channel of the downward link that is constantly transmitted by each node B to the entire cell. This channel is used by the UTRAN to contact a UE when it is in idle mode or in connected mode in the CELL_PCH or URA_PCH state.

[0015] The radio resources in a cell type system are not unlimited. They are used to provide an entire set of services, especially the paging service. If paging requirements of the system can be reduced, then it will be possible to reduce the size of the radio resources allocated to the paging channel and thus allocate more ra-

dio resources to the other services of the system (for example to convey voice or data).

[0016] An aim of the invention is to reduce the paging requirements of the system in order to reduce the size of the radio resources allocated to the paging channel in a UMTS system.

[0017] Indeed, the paging channel requirements of the presently used UMTS system are great. Let us take the example of a UE 30 communicating with the MSC 10 as shown in Figure 2. The UE 30 which is in a CELL_DCH or CELL_FACH state is connected with the MSC 10 through the SRNC 20 and the DRNC 21. This connection is represented by an arrow with dotted lines going from MSC 10 to the UE 30. The SGSN 11 then tries to transmit signalling information and/or data packets to the UE 30. The SGSN 11 therefore sends paging messages in the zone RA that is associated with it to contact the UE 30. It therefore transmits messages to the RNCs 20, 21, 22 and 23, asking them to send paging messages into the cells that they control.

[0018] At the UTRAN, the RNC 20 is the SRNC for the connection in progress of the UE 30. As the case may be, the RNC 21, acting as a DRNC for the connection in progress, also knows the state of the UE 30. These two RNCs are the only ones to know that the UE 30 is already in connected mode with the MSC. The other RNCs perceive the UE 30 as being in idle mode. The result of this is that the RNCs 22, 23 unnecessarily send paging messages through the paging channels of the cells that they control.

[0019] If the UE 30 is in the URA_PCH state, the situation is somewhat identical. All the RNCs controlling the cells of the RA zone send paging messages and therefore all the RNCs controlling cells outside the URA unnecessarily send paging messages, except for the SRNC which does not send paging messages if it is outside the URA.

[0020] Finally, if the UE 30 is in a CELL_PCH state, all the RNCs controlling the cells of the RA zone, other than the SRNC and the DRNC controlling the cell in which the UE 30 is located if it is distinct from the SRNC, also unnecessarily send paging messages.

[0021] It is observed therefore that the radio resources allocated to the paging channel are unnecessarily encumbered in the present system. This arises chiefly out of lack of coordination between the different elements of the core network and of the UTRAN.

[0022] It is therefore an aim of the invention to eliminate any unnecessary sending of paging messages through the paging channel in order to release radio resources for the other services of the network.

[0023] An object of the invention is a mobile radio telecommunications system comprising a core network communicating by means of a UTRAN network with a plurality of user equipments, said core network comprising a mobile switching centre and at least one serving GPRS support node, each user equipment being able to work selectively in two operating modes, firstly a connected mode in which the resources of the system are allocated to setting up a connection between the user equipment and said mobile switching centre and/or at least one serving GPRS support node, and secondly an idle mode,

characterized in that said mobile switching centre and said at least one serving GPRS support node communicate by means of an interface, said interface being designed to give said at least one serving GPRS support node the identity of the user equipments in connected mode with said mobile switching centre,

and in that, to page one of the user equipments in connected mode with said mobile switching centre, said at least one serving GPRS support node communicates with said user equipment through said mobile switching centre.

[0024] As an alternative embodiment, the interface between said mobile switching centre and said at least one serving GPRS support mode gives said at least one serving GPRS support node not only the identity of the user equipments in connected mode with said mobile switching centre but also the identity of the serving radio network controllers for the corresponding connections. Said at least one serving GPRS support node then directly transmits the paging messages to the serving radio network controllers without going through the mobile switching centre.

[0025] The characteristics and advantages of the invention shall appear more clearly from the following detailed description made with reference to the appended drawings, of which:

- Figure 1, already described, represents the architecture of a standard UMTS system;
- Figure 2 illustrates an example of the management of the radio resources allocated to the paging channel in a prior art system; and
- Figure 3 illustrates an example of the management of the radio resources allocated to the paging channel in a system according to the invention.

[0026] According to the invention, it is planned to modify the Gs interface between the MSC 10 and the SGSN 11 so that the SGSN 11 is regularly informed of the identity of the UEs in connected mode with the MSC 10.

[0027] The information on the identity of the UEs in connected mode is transmitted to the SGSN 11 either on the request of this SGSN 11 or on the initiative of the MSC 10. In the latter case, the information is for example sent periodically to the SGSN 11 or as soon as a UE goes into connected mode with the MSC 10.

[0028] When the SGSN 11 seeks to contact a UE, it verifies whether or not this UE is already in connected mode with the MSC 10. If this is not the case, it sends paging messages to all the cells of the associated RA. If it is the case, it sends a paging message to the MSC 10 which transmits it to the UE through its connection

with its UE.

[0029] Thus, the MSC 10 will carry out maximum paging only for cells under the control of the SRNC 20 and/or the DRNC 21. If the UE is in a CELL_DCH or CELL_FACH state, the paging message is transmitted to the DCH or FACH channel with the data coming from the MSC 10. This case is illustrated in Figure 3 which has to be compared with Figure 2.

[0030] In this figure, the SGSN 11 seeks to contact the UE 30 in connected mode with the MSC 10 and, as in Figure 2, the UE 30 is in a CELL_DCH or CELL_FACH state.

[0031] According to the invention, the SGSN 11 knows that the UE 30 is in connected mode with the MSC 10. The SGSN 11 therefore sends a paging message to the MSC 10 which will retransmit this message to the UE 30 in the channel (DCH or FACH) used to transmit data to the UE 30. The unnecessary dispatch of paging messages through the cells controlled by the RNCs 21, 22 and 23 is avoided.

[0032] Similarly, if the UE 30 is in a URA_PCH state, the paging message coming from the MSC 10 will be broadcast only through the paging channel of the cells belonging to the URA. Finally, if the UE 30 is in a CELL_PCH state, the paging message will be sent only through the paging channel of the concerned cell.

[0033] This system substantially limits the use of the paging channels of the radio resources.

[0034] As a variant, it can be planned that the interface Gs will give the SGSN not only the identity of the user UEs in connected mode with the MSC but also the identity of the SRNCs for the corresponding connections. The SGSN then directly transmits the paging message to the SRNC without going through the MSC.

Claims

1. Mobile radio telecommunications system comprising a core network communicating by means of a UTRAN network with a plurality of user equipments (30), said core network comprising a mobile switching centre (10) and at least one serving GPRS support node (11), each user equipment being able to work selectively in two operating modes, firstly a connected mode in which the resources of the system are allocated to setting up a connection between the user equipment (30) and said mobile switching centre (10) and/or at least one serving GPRS support node (11), and secondly an idle mode,
   characterized in that said mobile switching centre (10) and said at least one serving GPRS support node (11) communicate by means of an interface (Gs), said interface being designed to give said at least one serving GPRS support node (11) the identity of the user equipments in connected mode with said mobile switching centre (11),
   and **in that**, to page one of the user equipments in connected mode with said mobile switching centre (10), said at least one serving GPRS support node (11) communicates with said user equipment through said mobile switching centre (10).

2. System according to claim 1, **characterized in that** said interface (Gs) is furthermore designed to give said at least one serving GPRS support node (11) the identity of the radio network controllers (20, 21, 22, 23) with which said mobile switching centre (10) is linked to communicate with said user equipments in connected mode,
   and **in that**, to page one of the user equipments in connected mode with said mobile switching centre (10), said at least one serving GPRS support node (11) directly communicates with the concerned serving radio network controller instead of going through said mobile switching centre (10).

3. System according to claim 1 or 2, **characterized in that** said interface (Gs) gives the identity of the user equipments in connected mode with said mobile switching centre (10) and possibly the identity of the radio network controllers with which said mobile switching centre is linked to communicate with said user equipments in connected mode, upon a request from said at least one serving GPRS support node (11).

4. A system according to claim 1 or 2, **characterized in that** said interface (Gs) gives the identities of the user equipments in connected mode with said mobile switching centre (10) and possibly the identity of the radio network controllers with which said mobile switching centre is linked to communicate with said user equipments in connected mode, regularly on the initiative of the mobile switching centre (10).

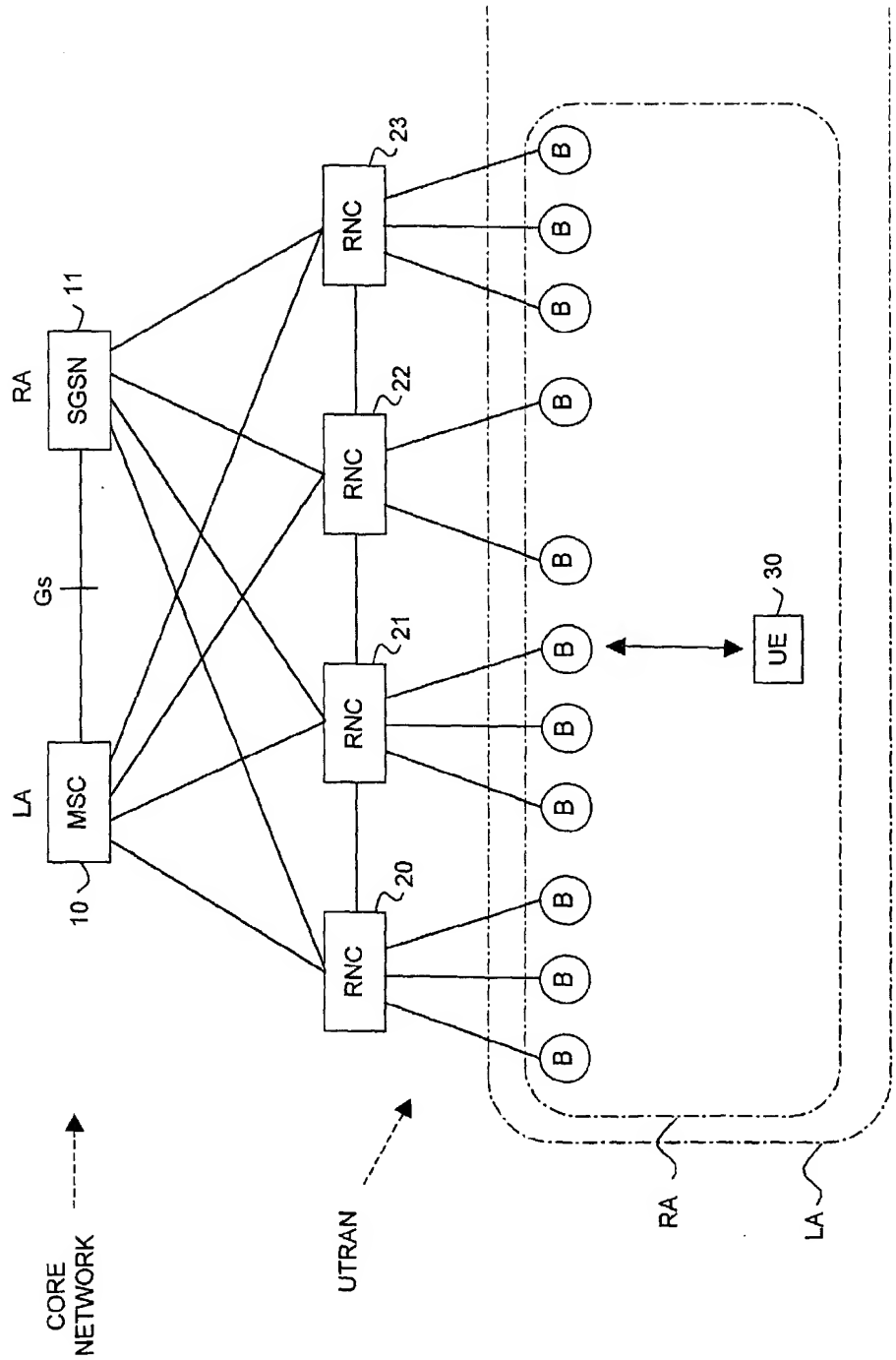
CORE NETWORK
UTRAN
LA
RA
MSC
SGSN
Gs
10
11
RNC
20
21
22
23
B
UE
30
RA
LA

FIG.1

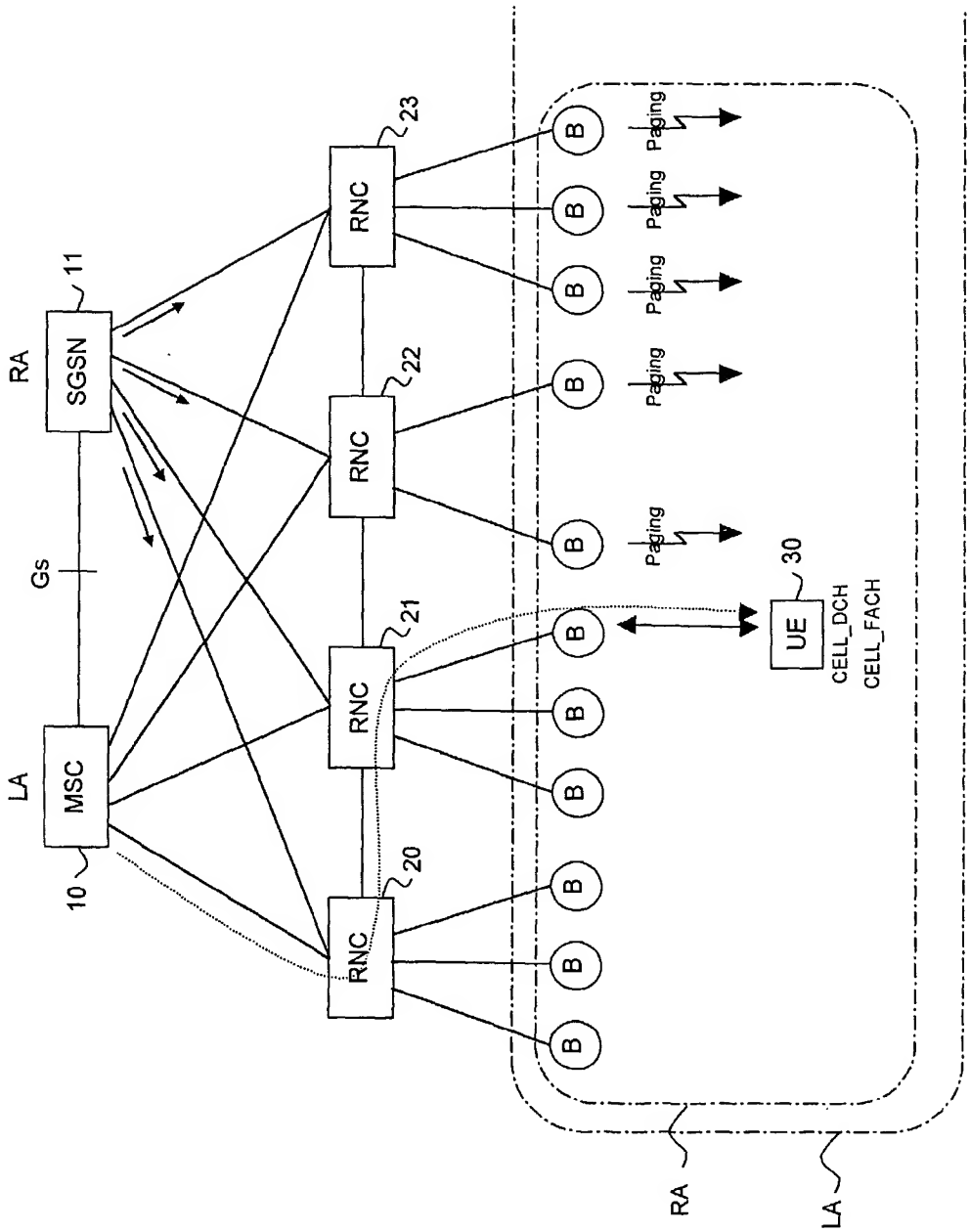

FIG.2
(prior art)

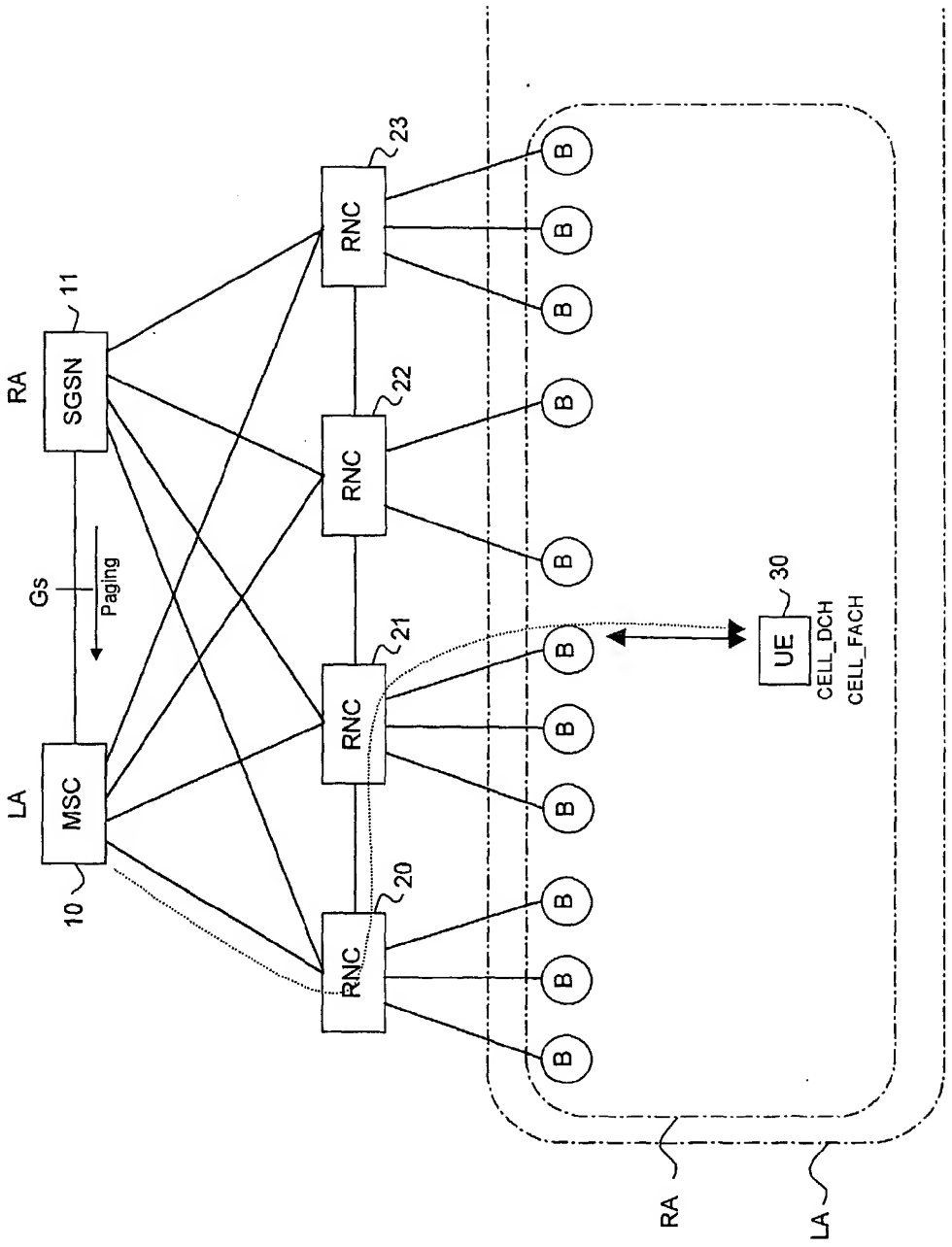
RA
SGSN
11
Gs
Paging
LA
MSC
10
RNC
23
RNC
22
RNC
21
RNC
20
B
UE
30
CELL_DCH
CELL_FACH
RA
LA

FIG.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 9518

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
E	WO 02 01907 A (NOKIA NETWORKS OY ;BACK JUHA (FI); HULKKONEN TONY (FI); HURTTA TUI) 3 January 2002 (2002-01-03) * abstract * * page 1, paragraph 1 - page 1, paragraph 4; figure 2 * * page 2, paragraph 4 - page 3, paragraph 2 * ---	1,3,4	H04Q7/38
A	WO 99 52317 A (NOKIA TELECOMMUNICATIONS OY ;AHMAVAARA KALLE (FI); VIALEN JUKKA (F) 14 October 1999 (1999-10-14) * abstract * * page 1, line 4 - page 3, line 22; figures 1,2 * ---	1	
A	US 6 081 723 A (MADEMANN FRANK) 27 June 2000 (2000-06-27) * abstract * * column 6, line 25 - column 7, line 4; figure 2 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04Q
H04L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	26 March 2002	Hultsch, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 9518

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-03-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0201907 A	03-01-2002	WO 0201907 A1	03-01-2002
WO 9952317 A	14-10-1999	FI 980783 A	04-10-1999
		AU 3150299 A	25-10-1999
		BR 9909396 A	05-12-2000
		CN 1296715 T	23-05-2001
		EP 1068758 A2	17-01-2001
		WO 9952317 A2	14-10-1999
US 6081723 A	27-06-2000	DE 19611947 C1	05-06-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82